



JUDGING THE EFFICACY OF ANTHRAX FUMIGATIONS

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Dorothy A. Canter, PhD.
US EPA



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ANTHRAX REMEDIATION PROCESSES

- Site assessment/environmental sampling
- Isolation of contaminated areas
- Artifact/critical item removal
- Source reduction/waste removal
- Decontamination of contaminated areas (e.g., fumigation)
- Post-remediation environmental sampling
- Further remediation/sampling (if needed)
- Disposal of PPE, waste water, debris





ANTHRAX-CONTAMINATED SITES WITH FUMIGATION REMEDIES

Sites	Nature of Contamination	Fumigant	Volume Fumigated	Fumigation Approach
Hart Bldg	Aerosolized	Chlorine dioxide (ClO ₂)	90,000 ft ³ 2 floors	All at once
DOJ mail facility	Secondary	Formaldehyde	4,000 ft ³	Machines tented
GSA Bldg 410	Secondary	Vaporized hydrogen peroxide (VHP)	1.6 x 10 ⁶ ft ³	9 zones
Brentwood	Aerosolized	ClO ₂	14.5 x 10 ⁶ ft ³ 2 floors	All at once
SA-32	Aerosolized	VHP	1.4 x 10 ⁶ ft ³	10 zones
Trenton	Aerosolized	ClO ₂	6.1 x 10 ⁶ ft ³	All at once





FUMIGATION

- Definition: the process of applying smoke, vapor or a gas to a facility or room for the purpose of disinfecting or destroying pests*

* Webster's Dictionary





HISTORICAL ANTHRAX FUMIGATIONS WITH FORMALDEHYDE

- Biosafety hoods and laboratories in research and clinical settings
 - NIH recommendations
 - NSF/ANSI standard for Class II biosafety cabinets
- Containment areas (animal rooms and office areas), equipment/materials, and buildings at US Army Medical Research Institute of Infectious Diseases (USAMRIID)
 - Regulations for conducting fumigations



FUMIGATIONS IN RESPONSE TO 2001 ANTHRAX ATTACKS


- Most fumigations modeled after biomedical sterilization processes, with established ranges for process variables for all four process phases and use of biological indicators as measures of efficacy of process
 - Phases:
humidification (dehumidification);
conditioning; decontamination; aeration





PROCESS VARIABLE GOALS/REQUIREMENTS


Fumigant/ Facility	Process Variables			
	Temperature	Relative Humidity	Concentration	Duration of Treatment
ClO₂				
Hart Bldg	70-80° F	65-75%	750 ppm	≥12 hrs.
Brentwood	≥75° F	≥75%	750 ppm	≥12 hrs.
Trenton	≥75° F	≥75%	750 ppm	≥12 hrs.
VHP				
Bldg 410	not specified	≤40%	108 ppm	3 hrs
SA-32	70° F	≤40%	≥216 ppm	≥4 hrs.





BIOLOGICAL INDICATOR GOALS/REQUIREMENTS


Fumigant/ Facility	Biological Indicator Parameters			
	Surrogate species	Number used	Placement Strategy	Consequences of Positive Results
ClO ₂				
Hart Bldg	Multiple species	>>1/100 ft ²	Random	None
Brentwood	<i>B. subtilis var. niger</i>	≥1/100 ft ²	Random, biased, focused locations	None
Trenton	<i>B. subtilis var niger</i>	≥1/100 ft ²	Random stratified + hard to reach/ contaminated locations	Additional environmental sampling





BIOLOGICAL INDICATOR GOALS/REQUIREMENTS

Fumigant/ Facility	Biological Indicator (BI) Parameters			
	Surrogate species	Number used	Placement Strategy	Consequences of Positive Results
VHP				
Bldg 410	<i>B. subtilis var. niger</i>	>1/100 ft ²	Hard to reach/ contaminated locations	Re-fumigation if ≥1 +BI
SA-32	<i>B. stearo- thermophilus</i>	>1/100 ft ²	Hard to reach/ contaminated locations	Re-fumigation if ≥1 +BI





SA-32: SITE WITH MOST STRINGENT REQUIREMENTS

- All process conditions achieved throughout all four phases of fumigation cycle at all real-time monitoring points
- All chemical indicators (CIs) exhibit color change following exposure to VHP
- All BIs recovered aseptically negative for growth of *B. stearoothermophilus*
- Positive control BIs (5% of BIs) demonstrate growth
- Negative control BIs (5%) exhibit no growth





SA-32: SITE WITH MOST STRINGENT REQUIREMENTS

- If any of above requirements not met, zone had to be refumigated
 - One of 10 zones was re-fumigated; second fumigation met all requirements



HISTORICAL CRITERIA FOR SUCCESSFUL TREATMENT

- Biomedical sterilizations
 - FDA regulation: Subsequent growth or failure of BI microorganism to grow under suitable conditions indicates adequacy of sterilization
- USAMRIID fumigations
 - All BIs negative for growth of indicator spores, or fumigation repeated





CRITERIA FOR SUCCESSFUL FUMIGATIONS

- All process variables within prescribed ranges for all four phases of fumigation at all monitoring points
- All aseptically removed BIs negative for growth of indicator organism


If criteria not met, further treatment or additional environmental sampling, depending upon site-specific results





BUT

Extensive post-remediation
environmental sampling
required even if fumigation(s)
successful





ULTIMATE CRITERION FOR EFFECTIVE REMEDIATION

- No growth of *Bacillus anthracis* spores from all post-remediation environmental samples

